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1912), and to recall that the first two of the fifteen conditions mentioned by him as desirable in a systematic and adequate vector-notation were (in part):

1. It should disturb as little as possible the established notation of mathematical analysis. For example, i should be left to denote $\sqrt{-1} \dots$.
2. It may generalize, but not contradict, the notation and principles of algebra.—EDITOR.

BOOK REVIEWS.

EDITED BY W. H. BUSSEY, University of Minnesota.

TWO NEW TRIGONOMETRIES.

Plane Trigonometry and Tables. By GEORGE WENTWORTH and DAVID EUGENE SMITH. Ginn and Company, Boston, 1914. iv+188 and v+104 pages.

This text is a revised version of the old and widely known book of similar content of the "Wentworth series." With a few exceptions it consists of a partial rearrangement of a portion of the material of the older book, and users of the older book will have no difficulty in recognizing the text and many of the problems of the newer book. Besides some new problems, there have been added a few notes of a historical character, a chapter on logarithms and a chapter on graphs. In this latter chapter the graphs of some of the simpler algebraic functions as well as those of the six trigonometric functions are given. Why does not some author accidentally introduce a new idea into trigonometry by giving the figure for $y = \sin 2x$ or $y = \sin x + \cos x$? The broad treatment of trigonometric equations and identities, and the introduction of the radian are deferred to the end of the text. In its new dress the text will probably lose no old friends and may gain some new ones.

Plane Trigonometry with Tables. By C. I. PALMER and C. W. LEIGH. The McGraw-Hill Book Company, New York, 1914. x+156+132 pages.

The authors make no claim for novelty, new material, or any innovation in this book. They hope to give a better, clearer arrangement of the time-worn subject matter. It is noticeable that the explanation of logarithms forms a separate chapter, bound with the tables, and that in the trigonometry proper there is no crowding of their use into any particular place. The type chosen for the tables seems unfortunate, being tiresome to the eyes if the tables are used for any length of time.

The introductory chapter contains adequate and particularly clear explanations of directed angles and lines together with the graphical addition of each. With this as a basis and with the use of the ideas of rectangular and polar coordinates, the trigonometric functions of the general angle are defined and the simpler developments presented. After this has been done successfully, the special definitions of the trigonometric functions for the right-angled triangle are dragged in from nowhere in particular and for no particularly good reason, and then they are used a great deal. The simpler identities and the inverse functions, involving acute angles, are then introduced.

The following chapter, devoted to the right triangle, introduces the ideas of orthogonal projection, vectors and areas of sectors and segments. The authors assume that the angles used in these latter discussions are less than a right angle, which is of course very unfortunate. By using the graphs of the trigonometric functions, the authors lead up to the idea of the addition theorems, and then in a natural way introduce the idea of the many-valuedness of an inverse function. In most places from this point on, only the principal value of the inverse function is used.

In the discussion of the general addition theorems, the proofs are given for *admittedly* special cases and no attempt is made to mislead the student into thinking that the proofs given are general. Some indications are given for the extension of the proofs. Identities, direct and inverse, based on these theorems conclude the chapter. Then come chapters on oblique triangles, trigonometric equations, and De Moivre's theorem including hyperbolic functions. In this latter chapter only the elements of the hyperbolic functions are given, the idea apparently being to give some place to which to refer when the future need for these functions shall occur. In the discussion of the De Moivre theorem, the authors use $j = \sqrt{-1}$ which is extremely unfortunate even though the book is primarily for technical students and $a + jb$ is the standard representation of a complex number in electrical theory.

The number of problems, many of which come from the applications, is large. The arrangement of the material in the chapters is generally good and natural. A rearrangement of the chapters themselves, so as to defer the solution of all triangles until the end of the book, seems desirable, the idea being that *occasionally* trigonometry is taught by teachers who have no proper perspective as to the future need for trigonometry in mathematics, over-emphasis being frequently given to the solution of triangles and more important subjects skimmed.

C. F. CRAIG

Geometrical Researches on the Theory of Parallels. By NICHOLAUS LOBATSCHESKI.

Translated from the original by GEORGE BRUCE HALSTED. New Edition.

The Open Court Publishing Company, Chicago, 1914. 50 pages. \$1.25.

This is a new edition of a work which appeared in 1891. The desirability that such classics of mathematical literature should be available even to those students who do not have command of any foreign language is recognized by mathematicians the world over. France and Germany have been unusually progressive in such matters, and Italy is just inaugurating a series of the classics. The beautiful simplicity of these masterpieces is a source of encouragement to young students to continue their studies. When a real interest is aroused in non-euclidean geometry or other topic, the study soon extends to the various fields of mathematical research which are so closely and so curiously inter-related. The student of the history of science is particularly interested in the fact that the names of Bolyai and Lobatschewski, independent workers, are indissolubly linked